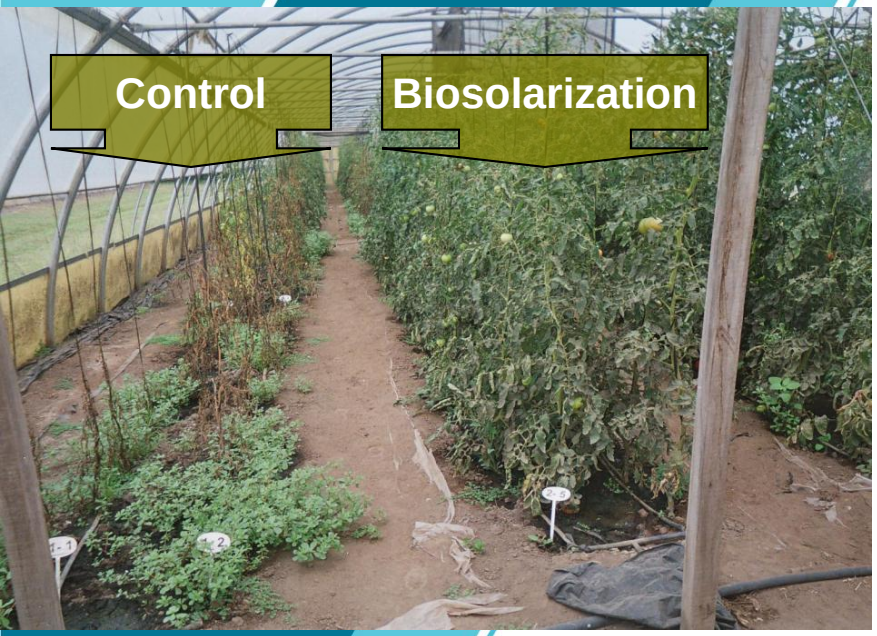
Biofumigation 7
plants for soil health
www.agroscope.ch/biofumigation7
22-26 March 2021
on-line Event



Horticultural crop health and yield and greenhouse soil conditions after 17 years of repeated treatments of biofumigation and solarization

Mitidieri, M. S.; Brambilla, V.; Barbieri, M.; Piris, E.; Celié, R.; Peralta, R.

INTA San Pedro
Buenos Aires
Argentina

INTA

Ministerio de Agricultura, Ganadería y Pesca
Argentina

The combination of biofumigation and solarization is commonly known as biosolarization.

Biosolarization

+

Solarization + biofumigation

A experience was performed from 2003 to 2019 in a greenhouse at INTA San Pedro, Buenos Aires province, Argentina (33°44'12.7"S 59°47'58.2"W).

Treatments (TRAT) were applied every two years

Treatments: 1=Control; 2= Solarization, 3= BIOROT, was a succession of organic amendments (chicken manure, broccoli, chicken manure, broccoli, tomato and pepper crop debris, mustard, tomato crop debris + purslane, broccoli, tomato debris), 4=BIOBRAS was based only on the use of brassicas (rape, broccoli, broccoli, mustard, mustard, mustard, *Brassica campestris,* broccoli, *Brassica campestris*).

	2003	2005	2007/08	2009	2011/12	2014	2016	2017/18	2019/20
Dates	14/11 to 19/12	25/11 to 26/12	18/12 to 29/01	18/11 to 29/12	2/12 to 3/01	22/01 to 10/02	19/01 to 15/02	21/12 to 25/01	11/12 to 17/01
Duration	35	31	42	41	32	12	27	36	37
Transplant date	6 /01/2004	20/10/2006	30/01/ 2008	5/01/ 2010	29/08/2012	24/02/2014	16/02 2016	21/08/2018	
Kg dry matter/m^2	Manure 1,71/ Rapeseed 0,49	Broccoli 2,53	Brocoli 0,76	Broccoli 2,87	Debris 0,70/ Mustard 0,38	Mustard 0,97	Tomato 1,44 + purslane 1,27/B. campestris 0,11	Broccoli 10,72	B.Campestris 7,5/Tomato debris 9,762
Days to transplant	18	174	2	7	235	14	1	147	

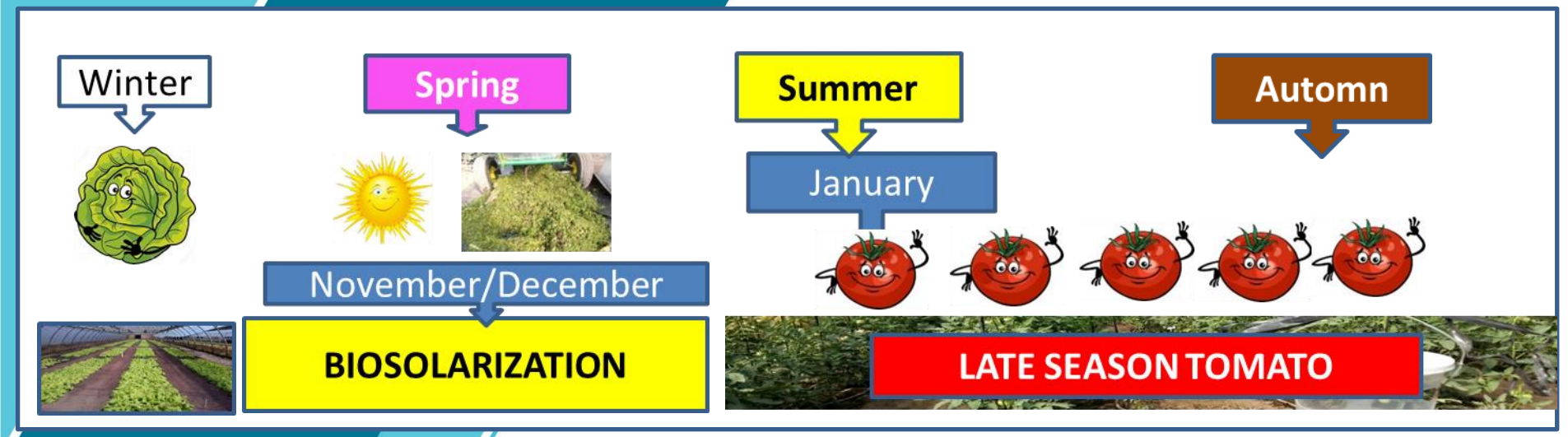
1. Control

2.Solarization

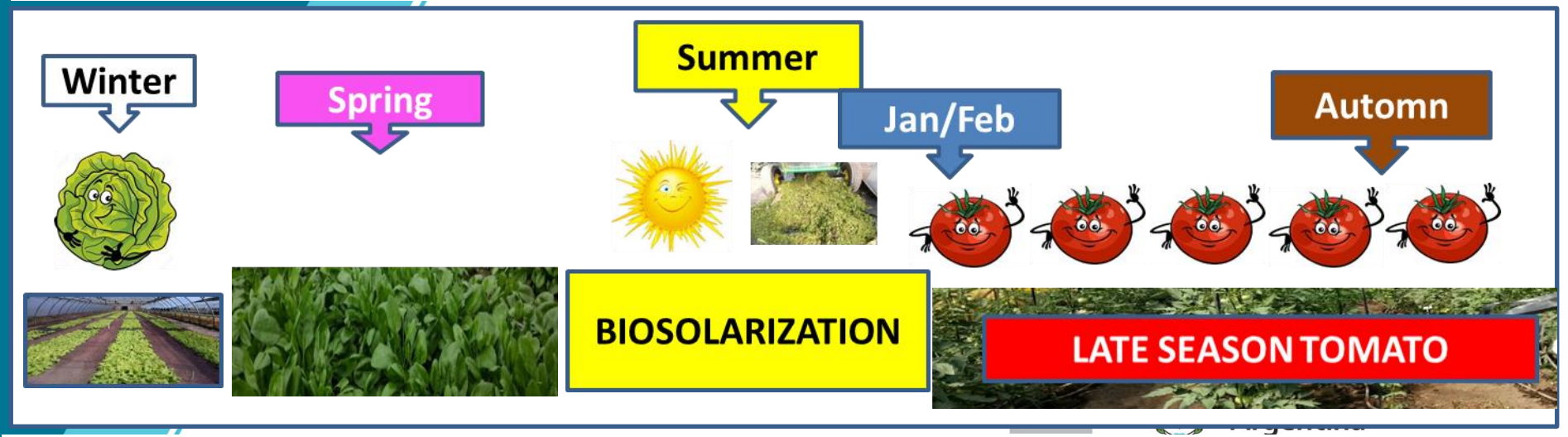
3.Biorot

4.Biobras

Treatments were carried out in spring (31-42 days)



Or in summer (12-37 days)



The tomato hybrid used was Superman (Petoseed), except for the last season were the hybrid used was Rodeo (BHN).

Some biofumigant examples:

Tomato and pepper debris

Mustard debris

Brocoli debris

Canola

Biosolarization with canola

Biosolarization with Broccoli

Biosolarization with Brassica campestris

Biosolarization with tomato and pepper residues

Tissue maceration with a chipper

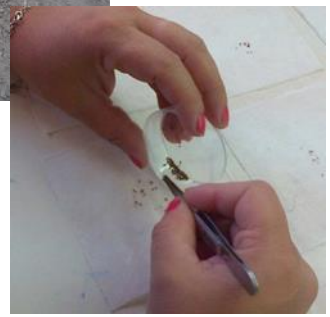
Incorporation with rototiller, installation of irrigation system

Cover with plastic

Nematode analysis

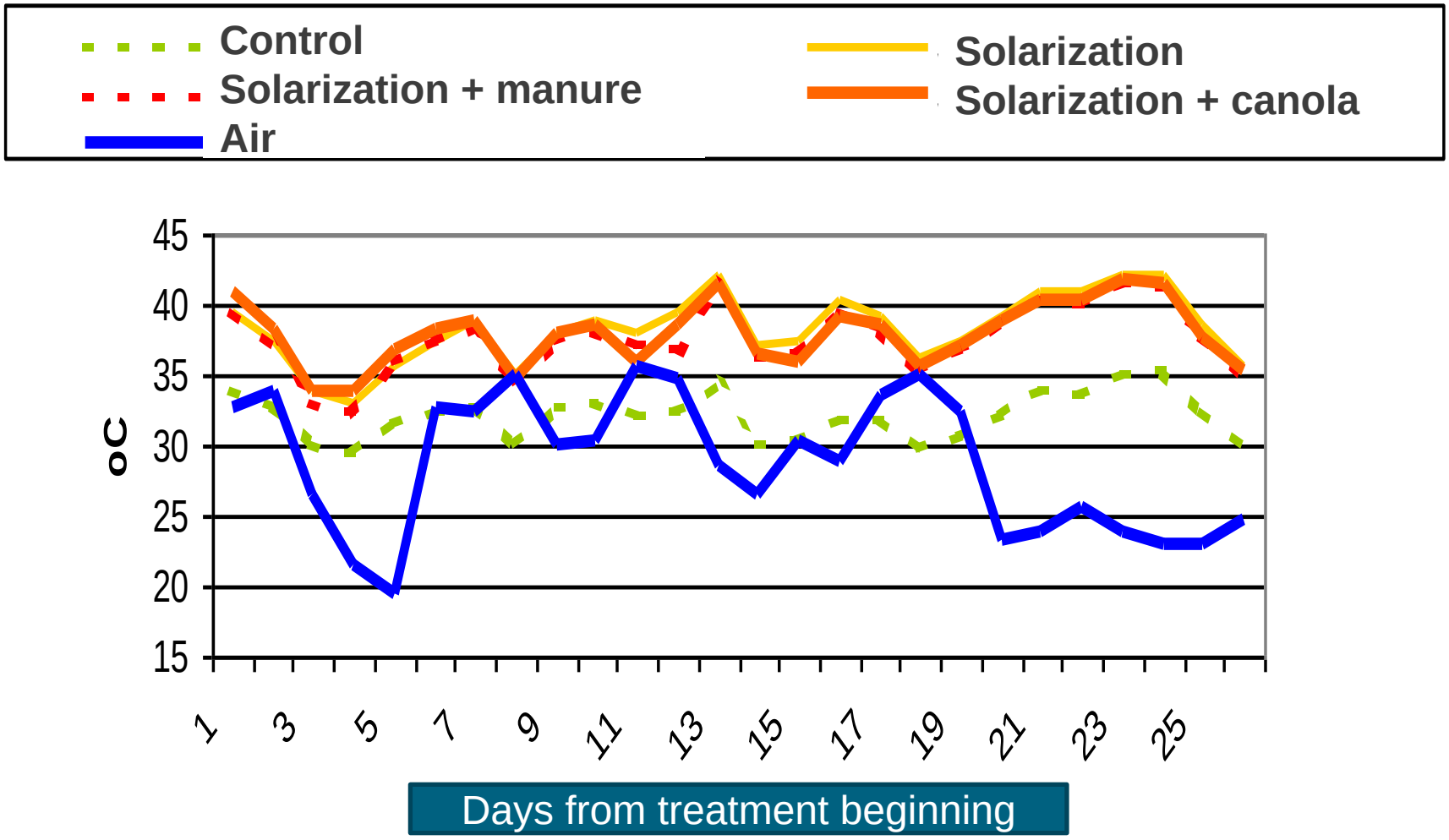
Soil borne pathogens and beneficial microorganisms

Soil properties

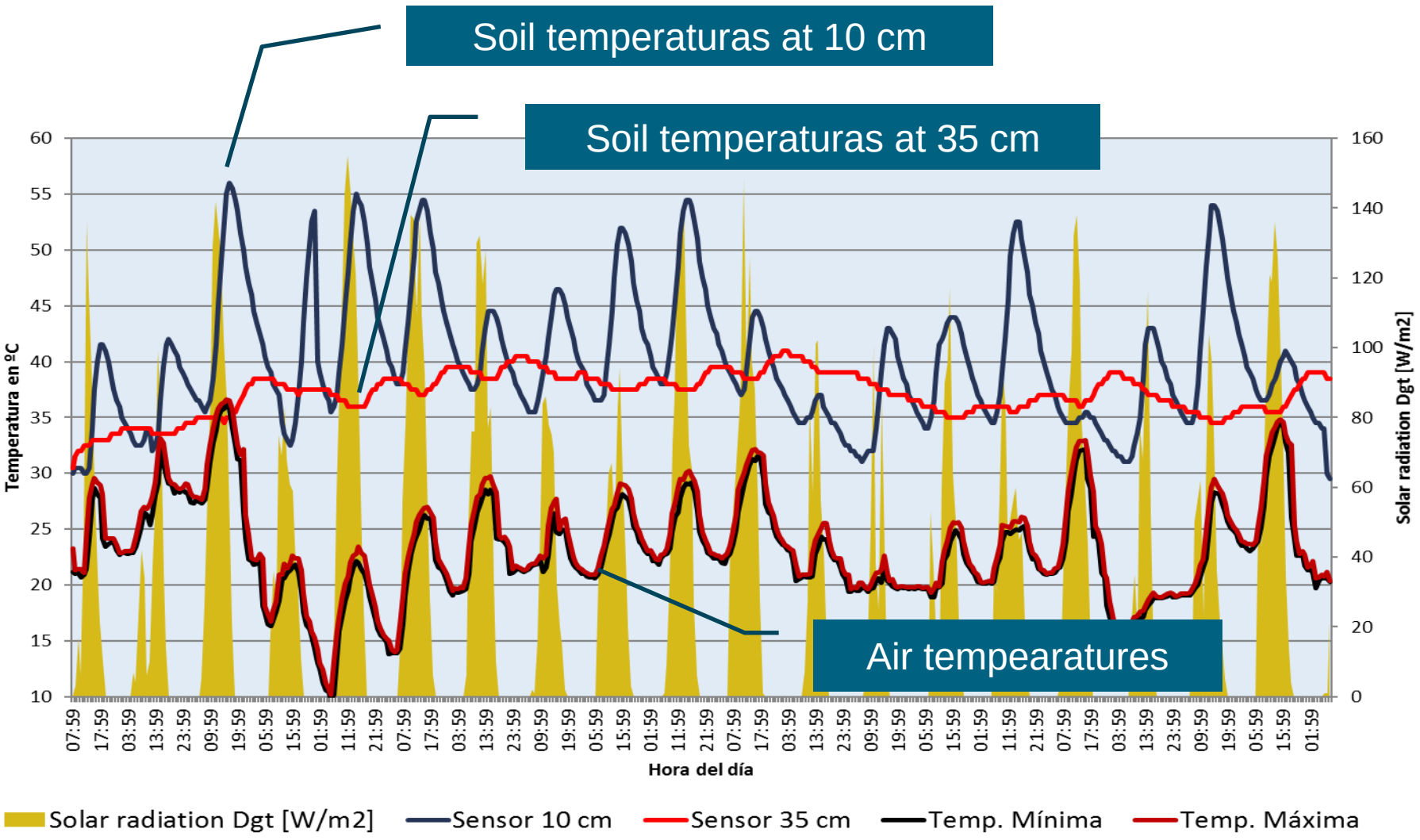


Air and soil temperatures during biosolarization

Spring: November 14 th to december 19 th 2003

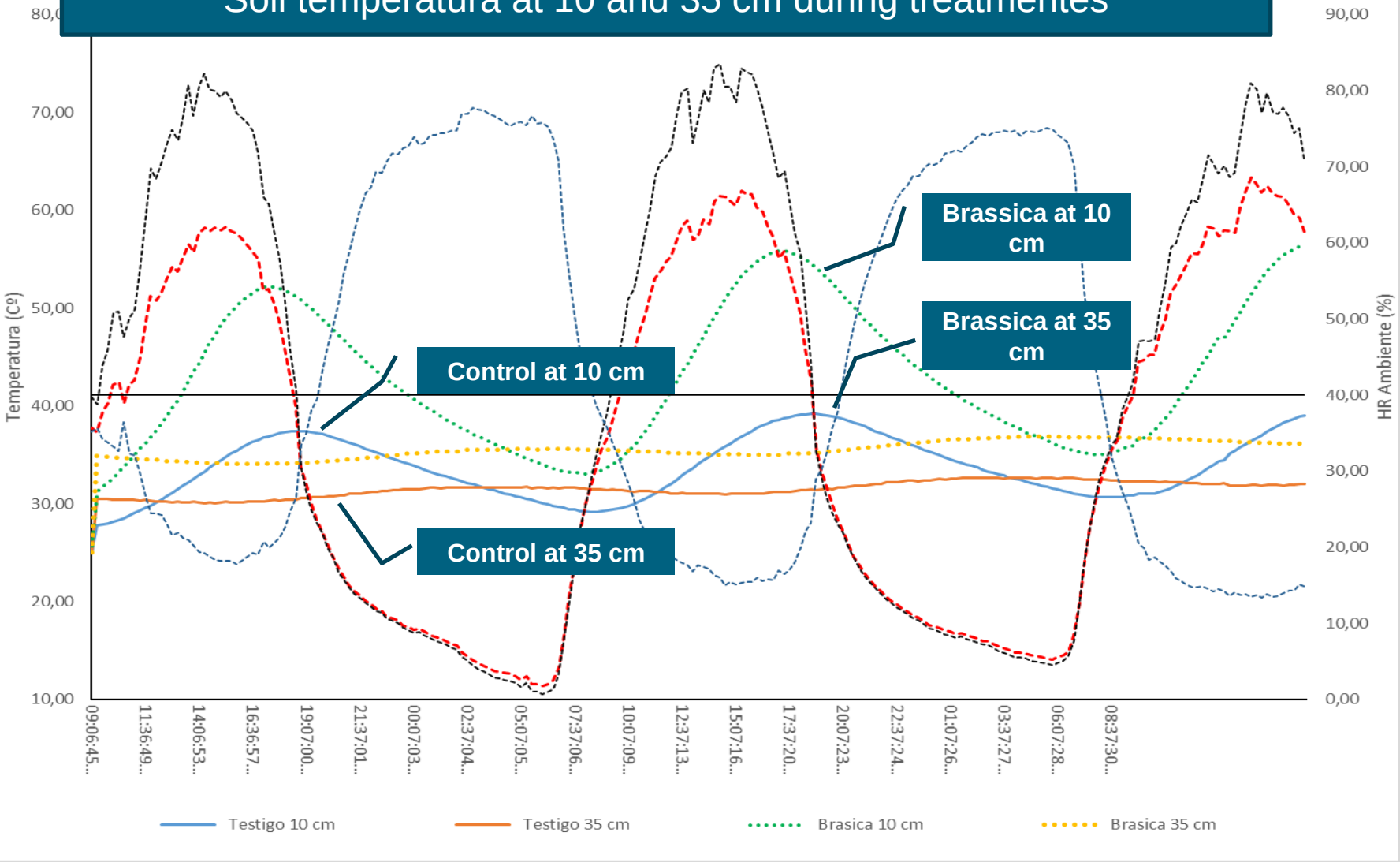


Summer January 22 th to february 10 th 2014



Summer December 21 th to January 16 th 2020

Soil temperatura at 10 and 35 cm during treatmentes

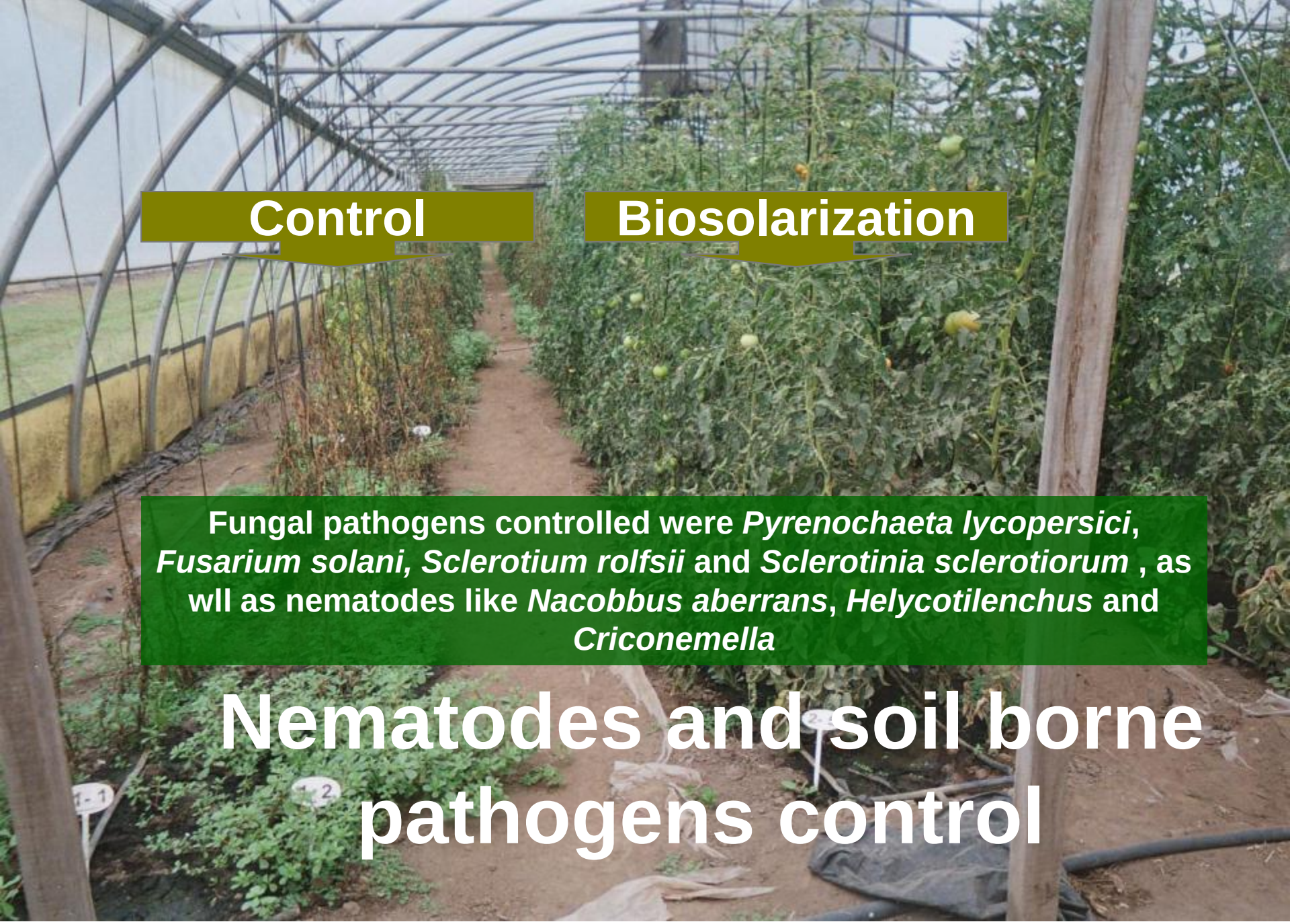


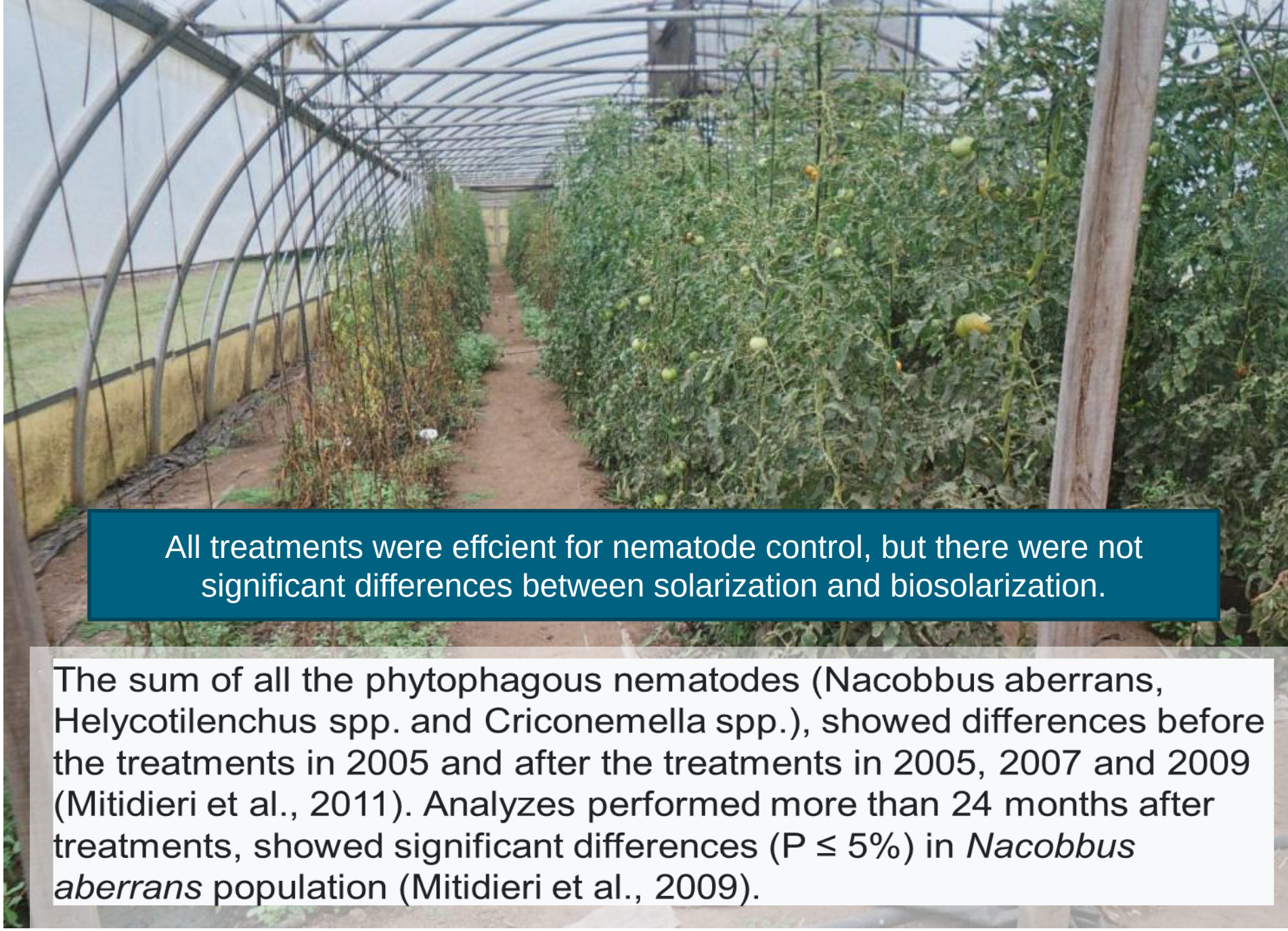
Results

Weeds and pathogens control

Weed control


Weed control


Control
Biosolarization
Fungal pathogens controlled were *Pyrenochaeta lycopersici*, *Fusarium solani, Sclerotium rolfsii* and *Sclerotinia sclerotiorum* , as wll as nematodes like *Nacobbus aberrans*, *Helycotilenchus* and *Criconemella*
Nematodes and soil borne pathogens control

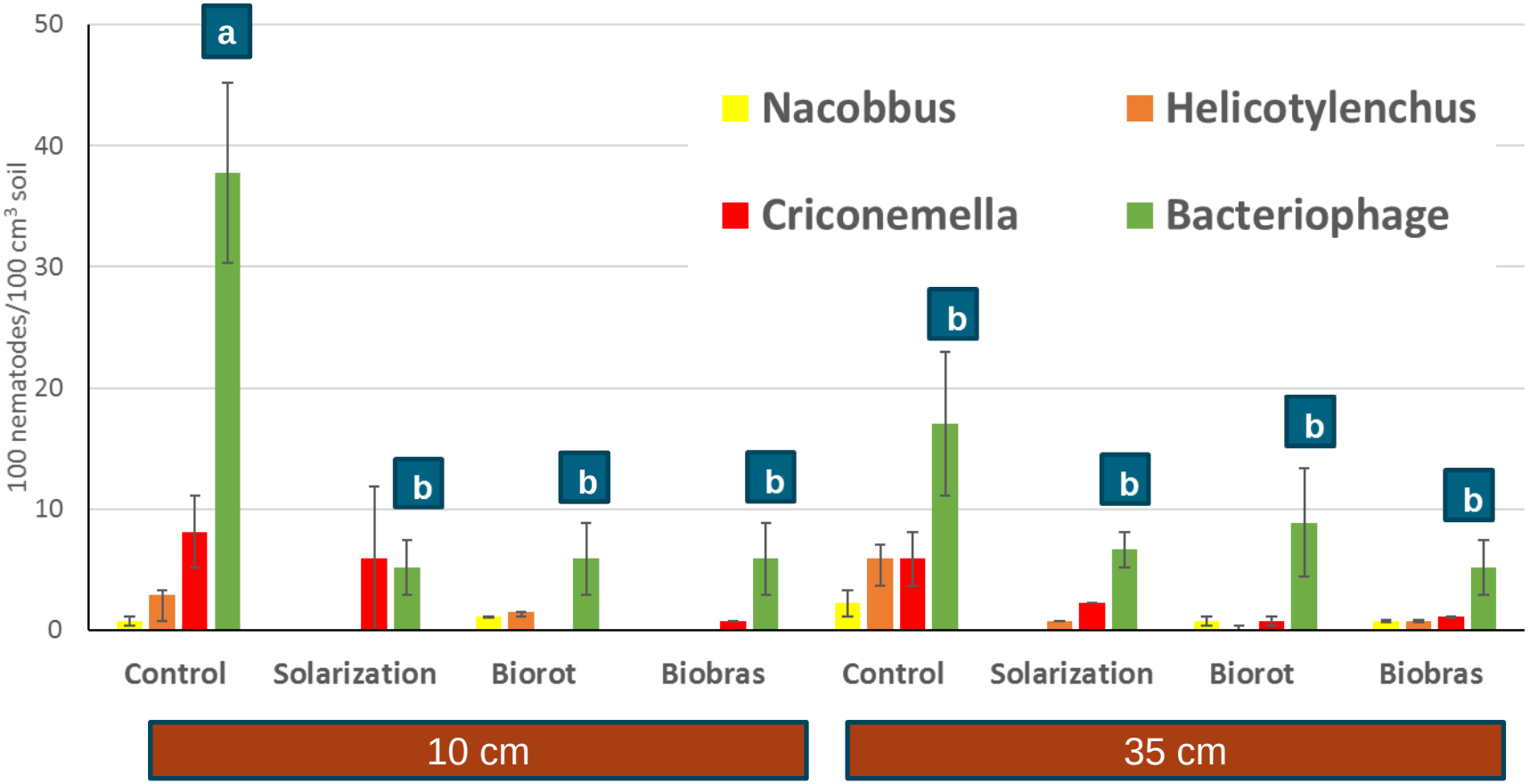


All treatments were effcient for nematode control, but there were not significant differences between solarization and biosolarization.

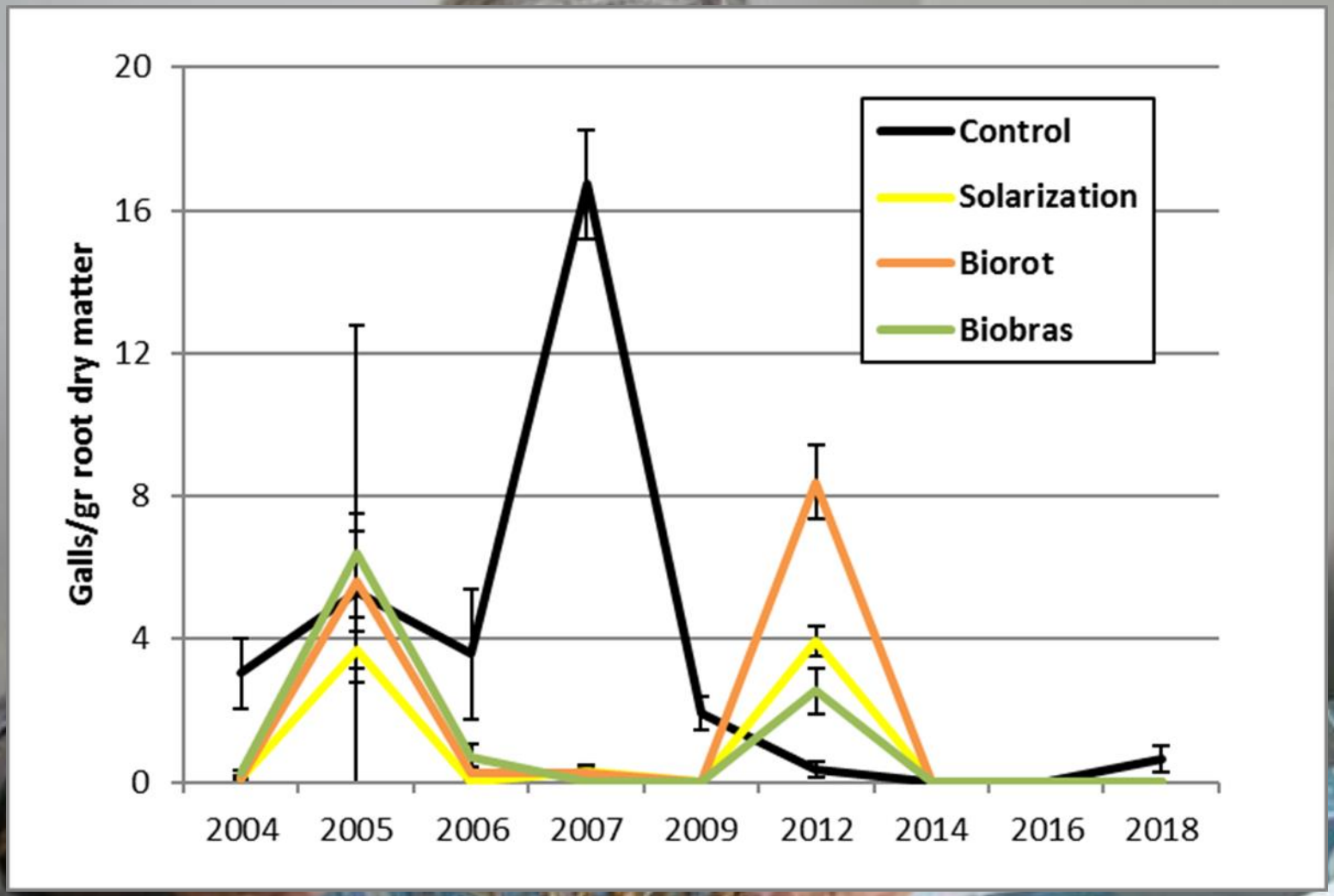
The sum of all the phytophagous nematodes (Nacobbus aberrans, Helycotilenchus spp. and Criconemella spp.), showed differences before the treatments in 2005 and after the treatments in 2005, 2007 and 2009 (Mitidieri et al., 2011). Analyzes performed more than 24 months after treatments, showed significant differences ($P \leq 5\%$) in *Nacobbus aberrans* population (Mitidieri et al., 2009).

Effect of treatments on phytophage and bacteriophage nematodes

Nematodes/100 cm3 of soil after treatments. December 2005. Biorot= Manure/Broccoli, Biobras= Rapeseed/Broccoli.
Media with different letters statistiscally differ for Duncan test at 5 %.



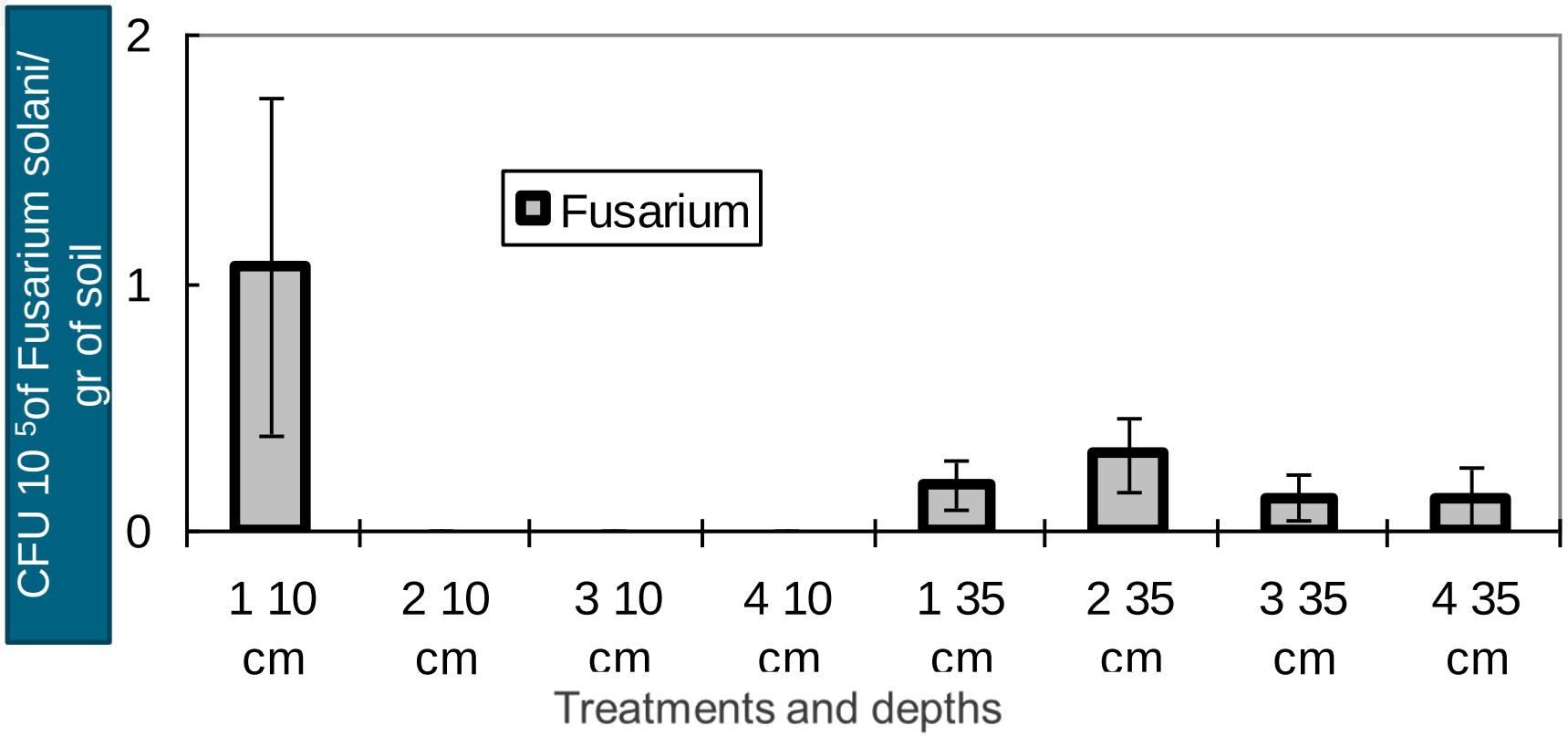
Effect of treatments *Nacobbus aberrans* incidence at the end of crop cycle of tomato



Biorot= succession of different organic matters, Biobras= biofumigation with Brassicas

Fusarium solani colonies in soil dilutions plated on APG growth media

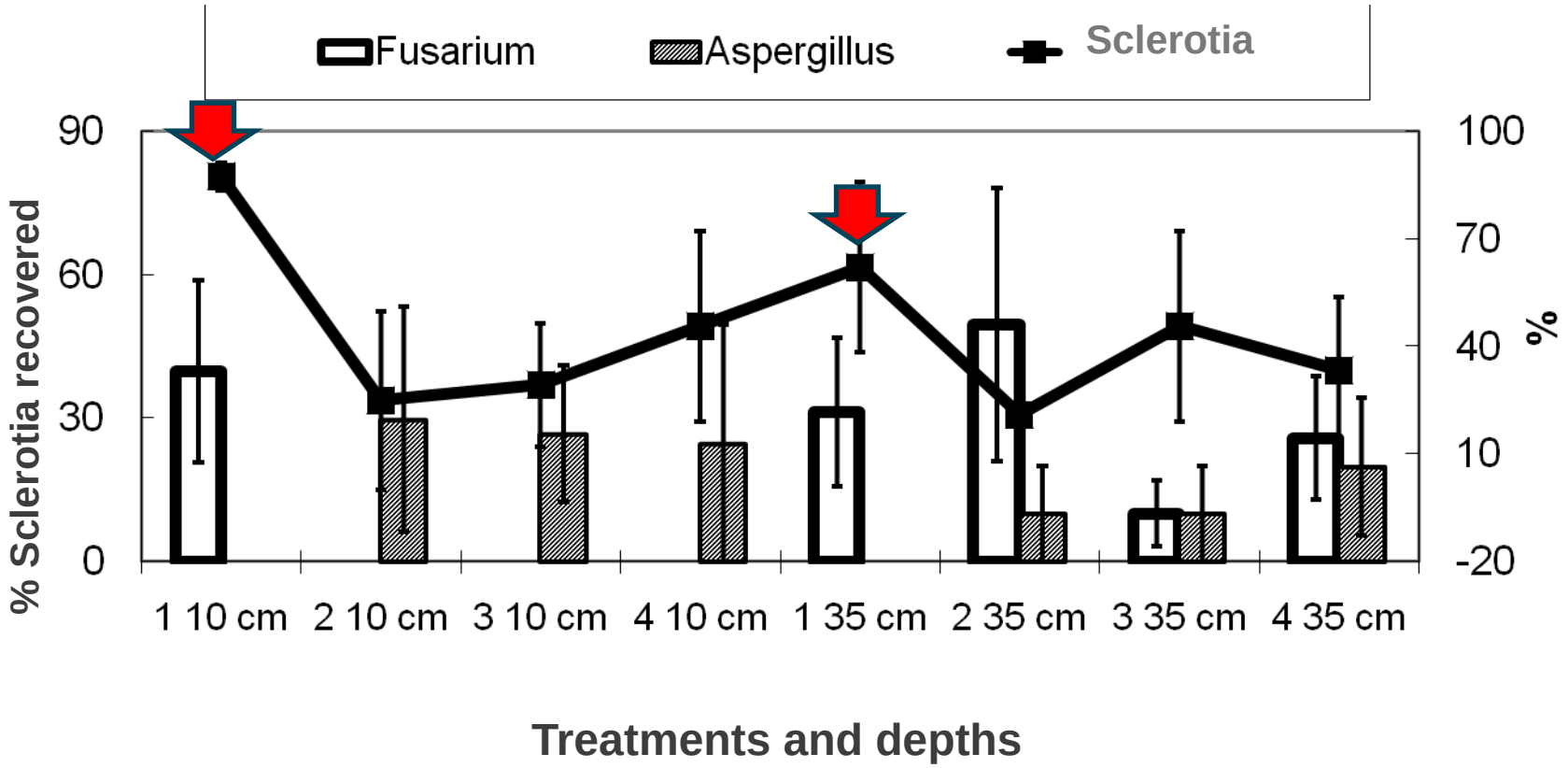
Samples obtained after treatments , december 2005



1. Control, 2. Solarization/Solarization. 3. Manure/Brocoli y 4. Rapeseed/ Brocoli.

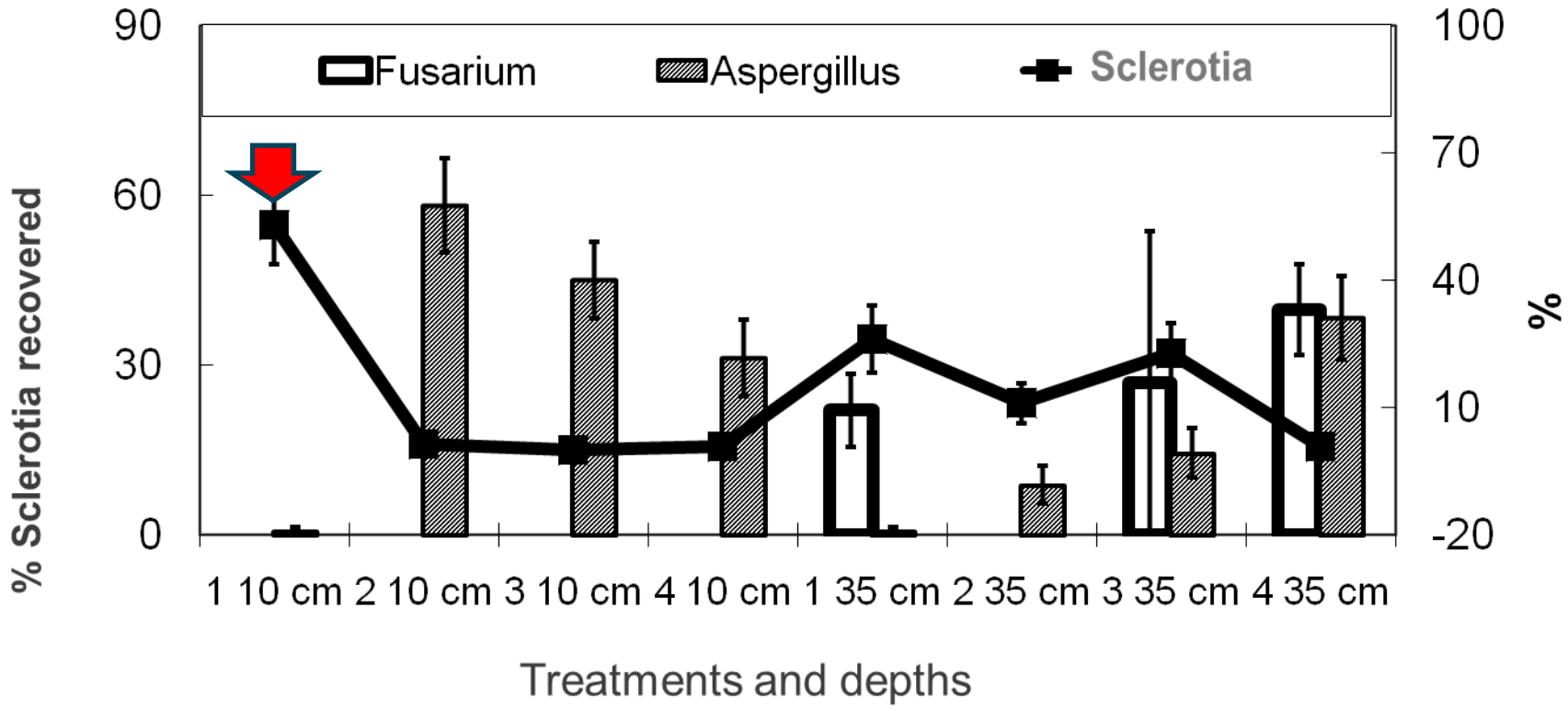
In 2005 significant differences (P ≤ 5%) were obtained for the interaction treatment by depth for *Fusarium solani* CFU. This pathogen was found at 10 cm only in the control, but in all treatments at 35 cm (Mitidieri et al., 2009).

Sclerotinia sclerotiorum sclerotia recovered after treatments. December 2005.



1. Control, 2. Solarization/Solarization. 3. Manure/Brocoli y 4. Rapeseed/ Brocoli.

Sclerotium rolfsii sclerotia recovered after treatments



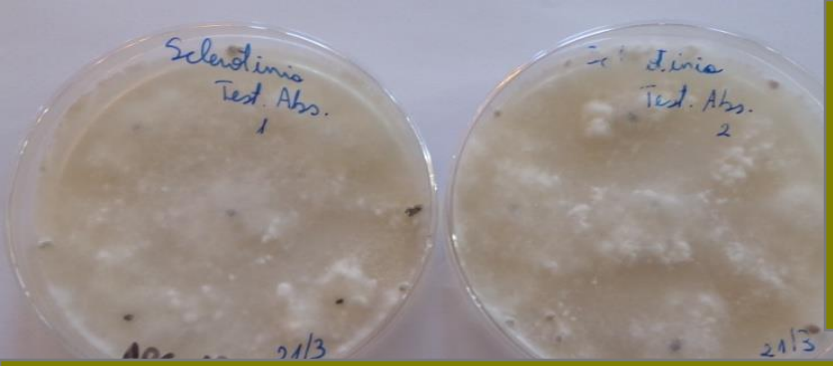
1. Control, 2. Solarization/Solarization. 3. Manure/Brocoli y 4. Rapeseed/ Brocoli.

In 2014, highly significant differences (P ≤ 1%) were obtained for the interaction treatment by depth, with a lower presence of the pathogen in the treated plots and at 35 cm.

Until now, colonies of *Pyrenochaeta lycopersici* could not be recovered after the treatments. This result could match with the fact that the pathogen attacks in periods of low temperatures, and its control by solarization is recommended.

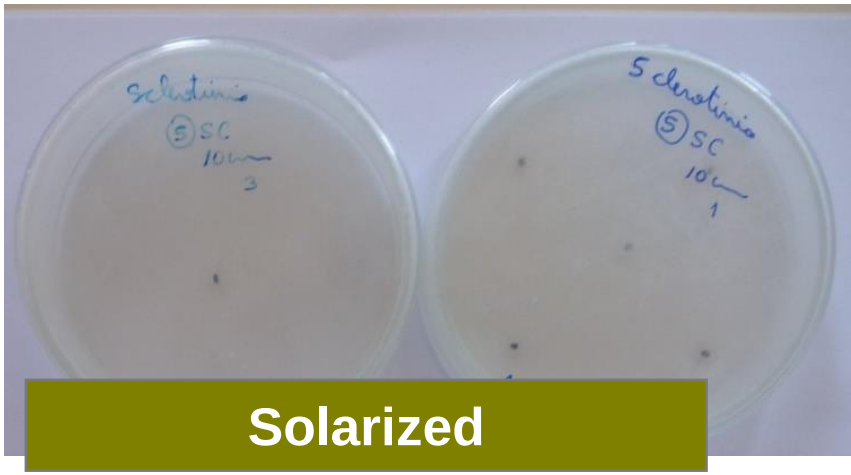
Regarding the presence of other pathogens, in 2009, a reduction in the population of *Pythium spp*. was observed (Mitidieri et al., 2011).

Sclerotinia Sclerotiorum control 19/01 to 15/02 2016



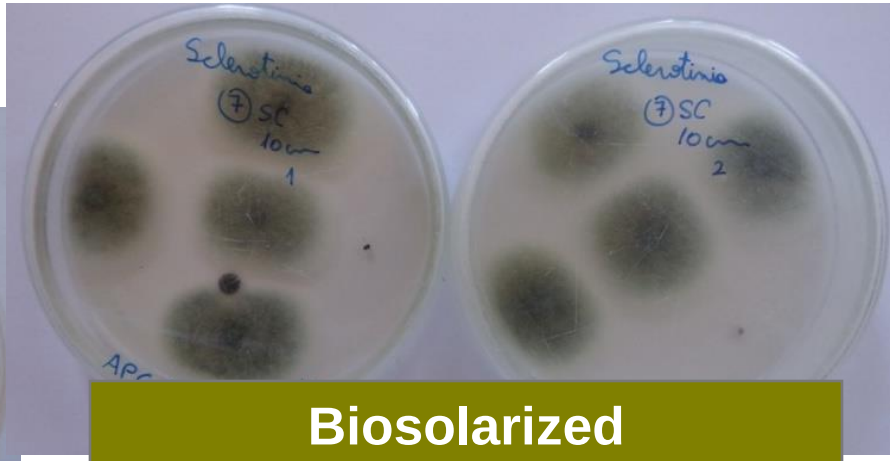
Sclerotia out of the greenhouse

Control



Solarized

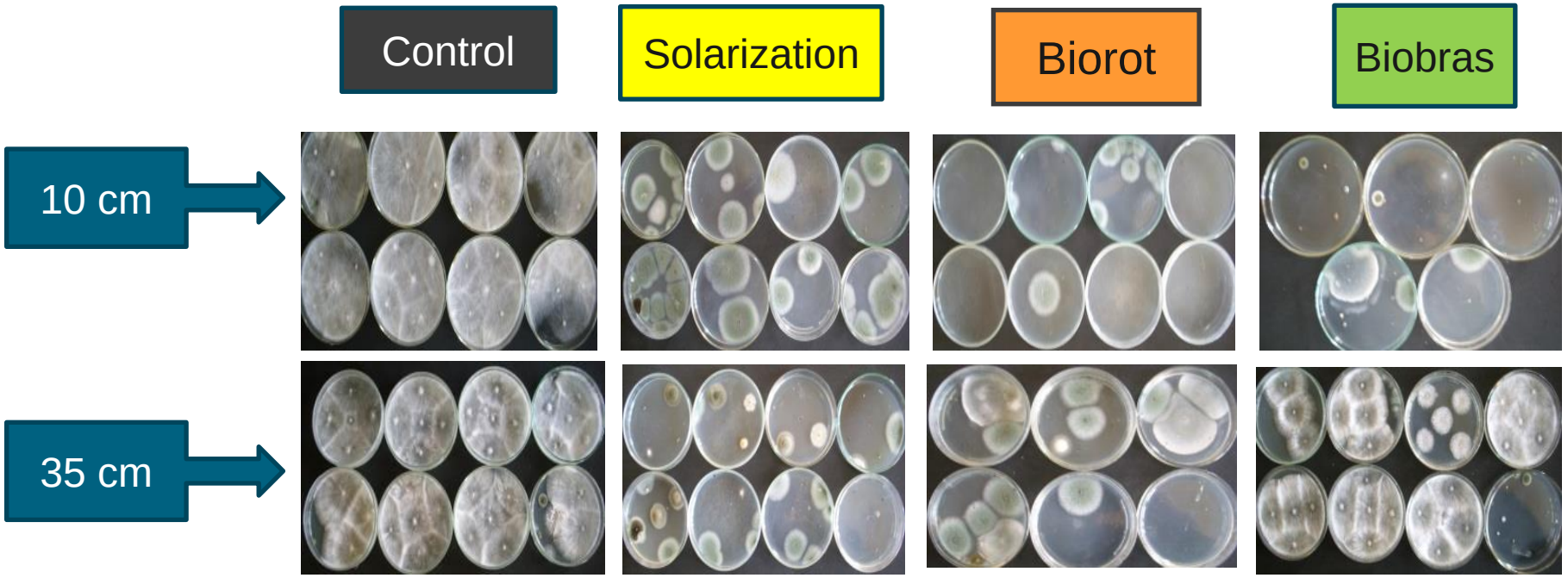
Biosolarized with tomato debris



Biosolarized
with Brassica campestris

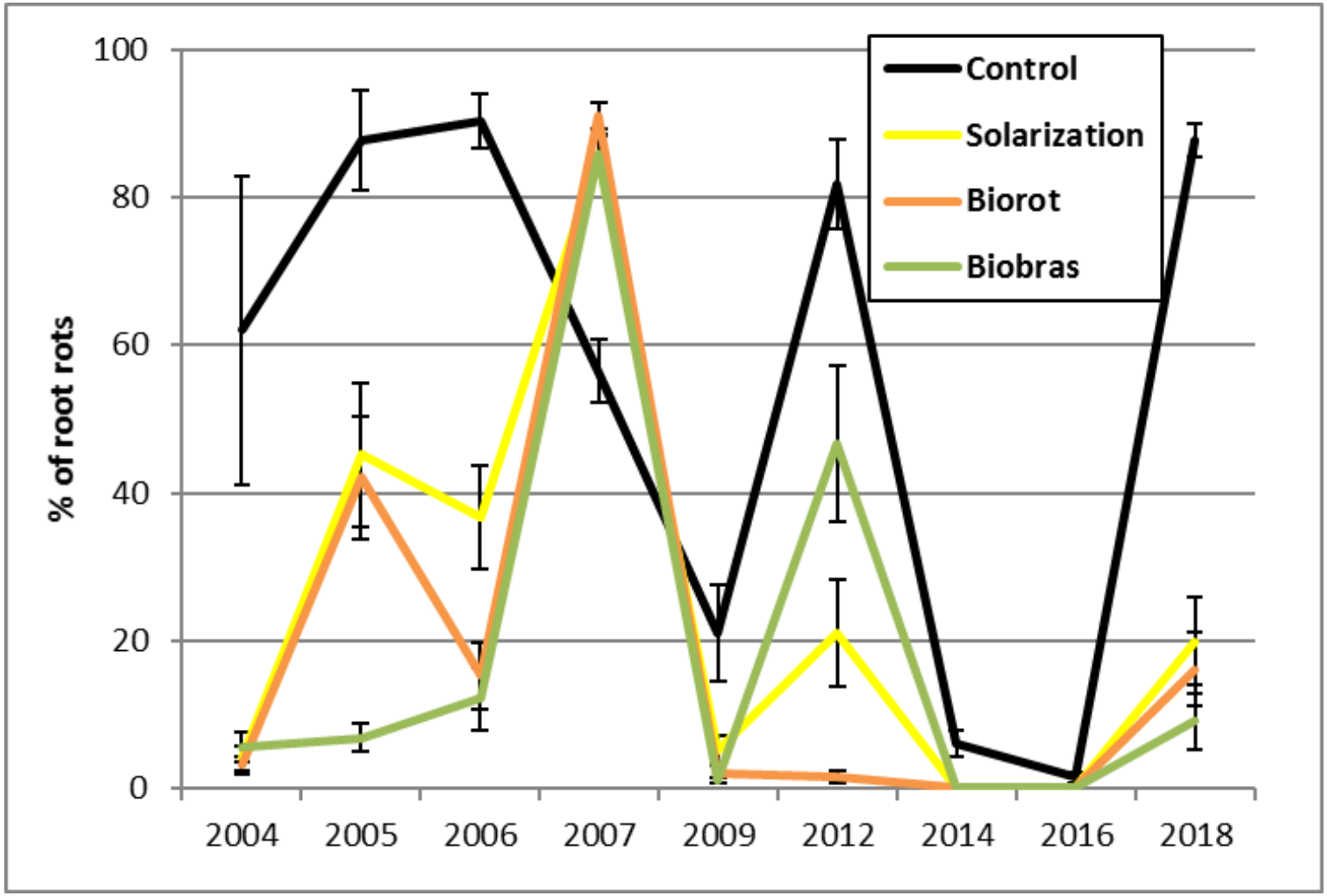
Germination of *Sclerotium rolfsii* after treatments

Fungus of Aspergillus genera were observed growing on death sclerotia in BIOBRAS and BIOROT.
18/12 2007 to 29/01 2008



Biobras= biosolarization with broccoli debris, Biorot= biosolarization with chicken manure

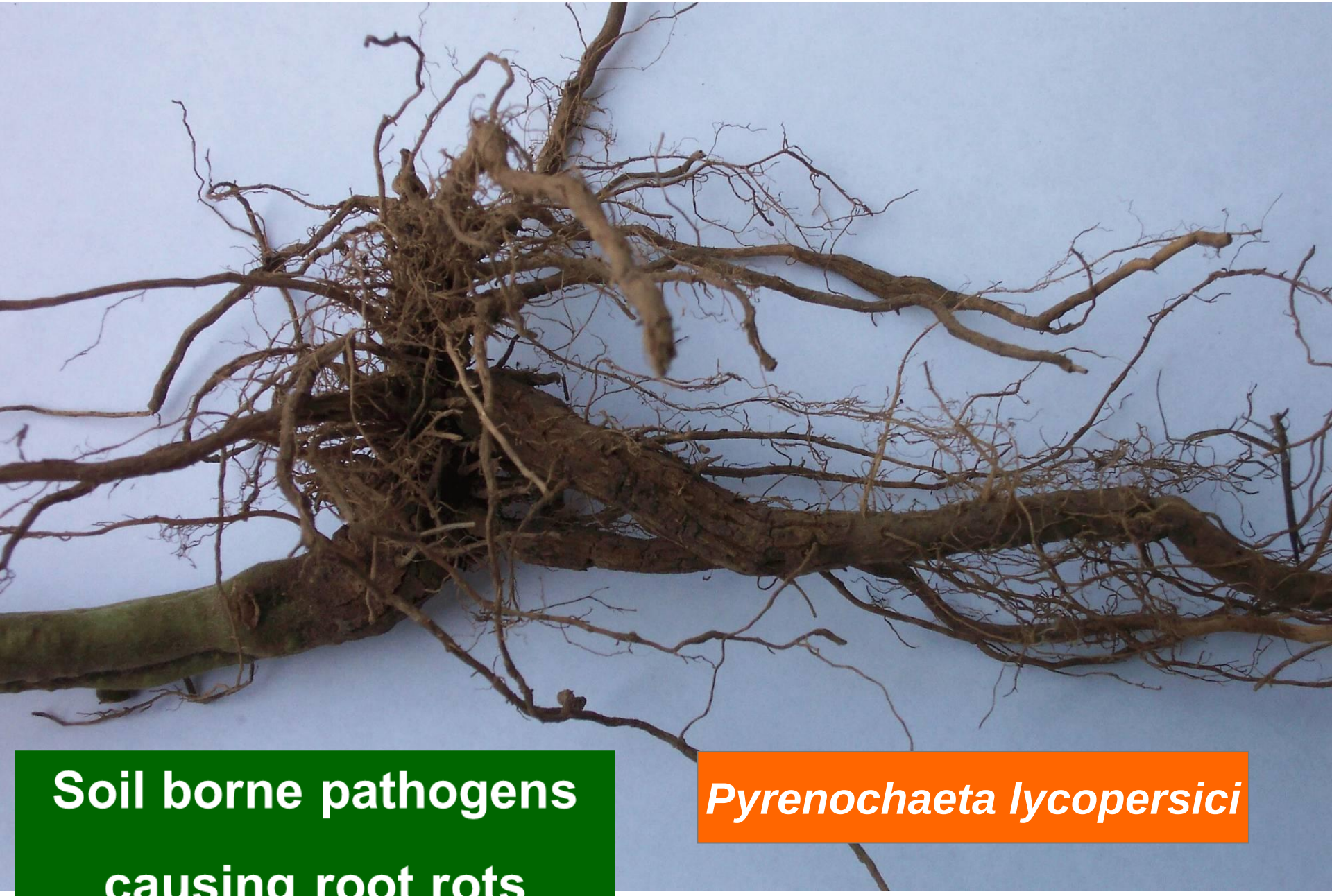
Tomato plants in control showed higher percentage of death plants, root rots and root dry matter at the end of each crop.



Biorot= succession of different organic matters, Biobras= biofumigation with Brassicas

Soil borne pathogens causing root rots

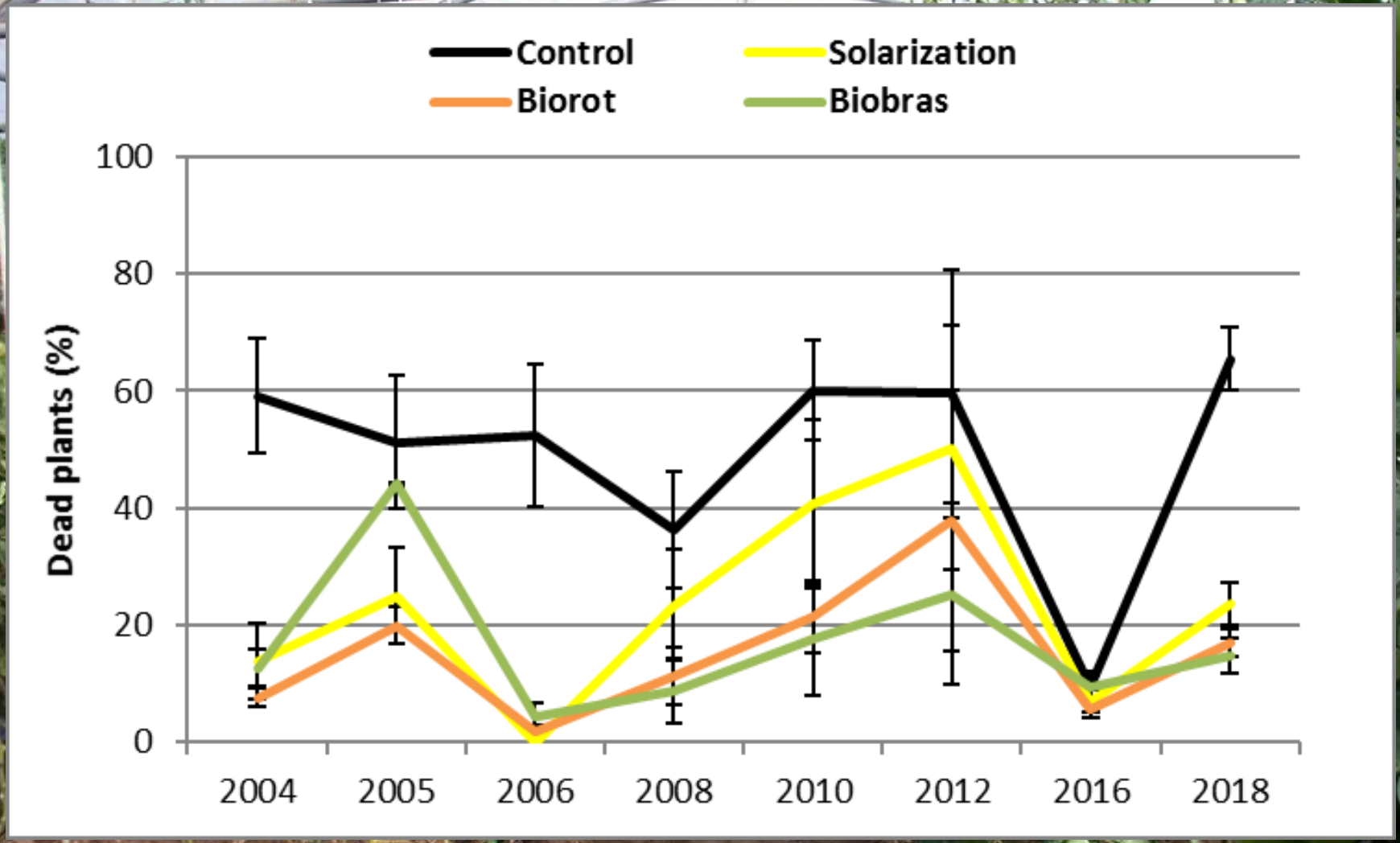
Fusarium solani



Soil borne pathogens causing root rots

Pyrenochaeta lycopersici

Effect of treatments on dead plants at the end of crop cycle of tomato



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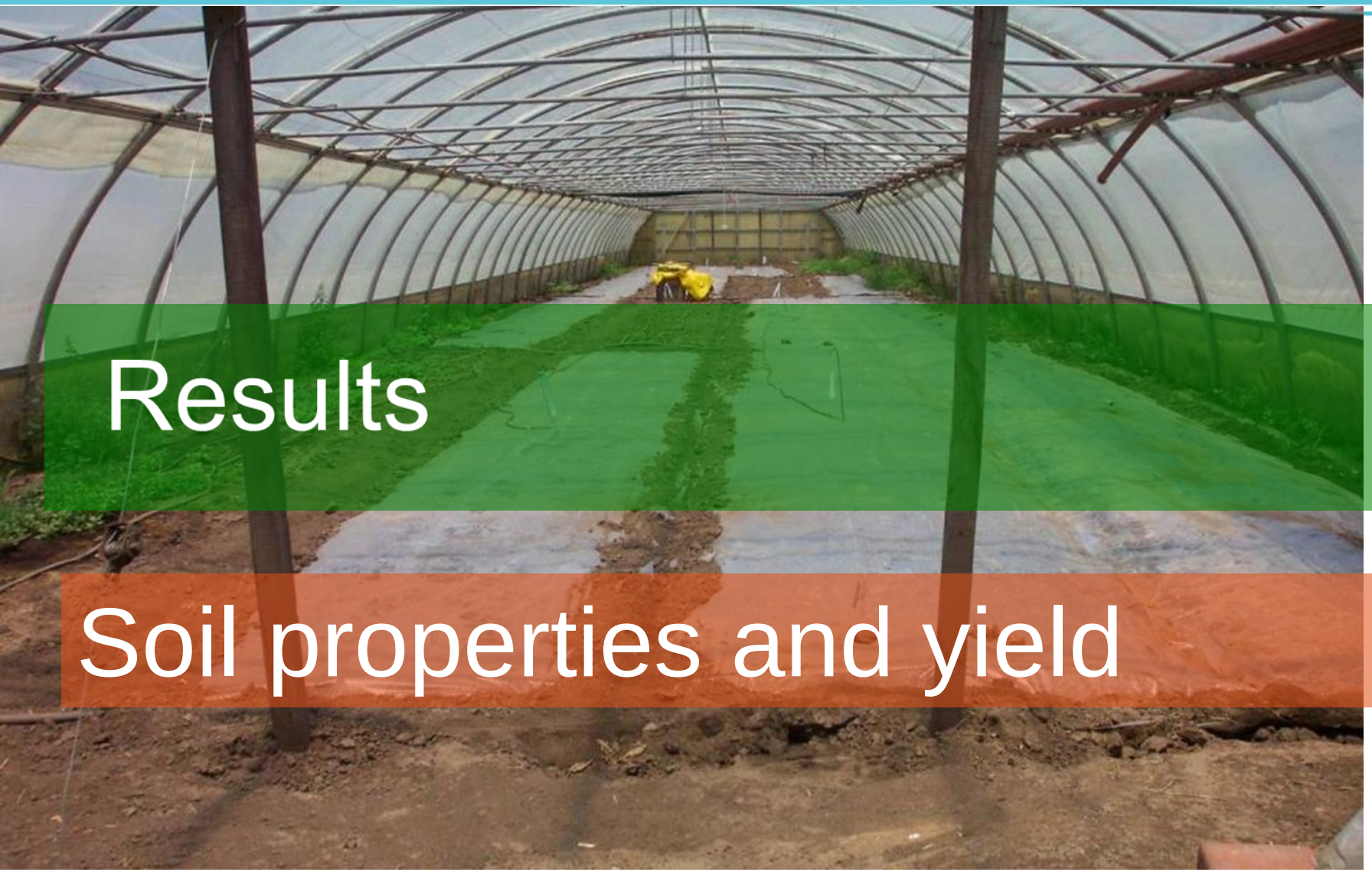
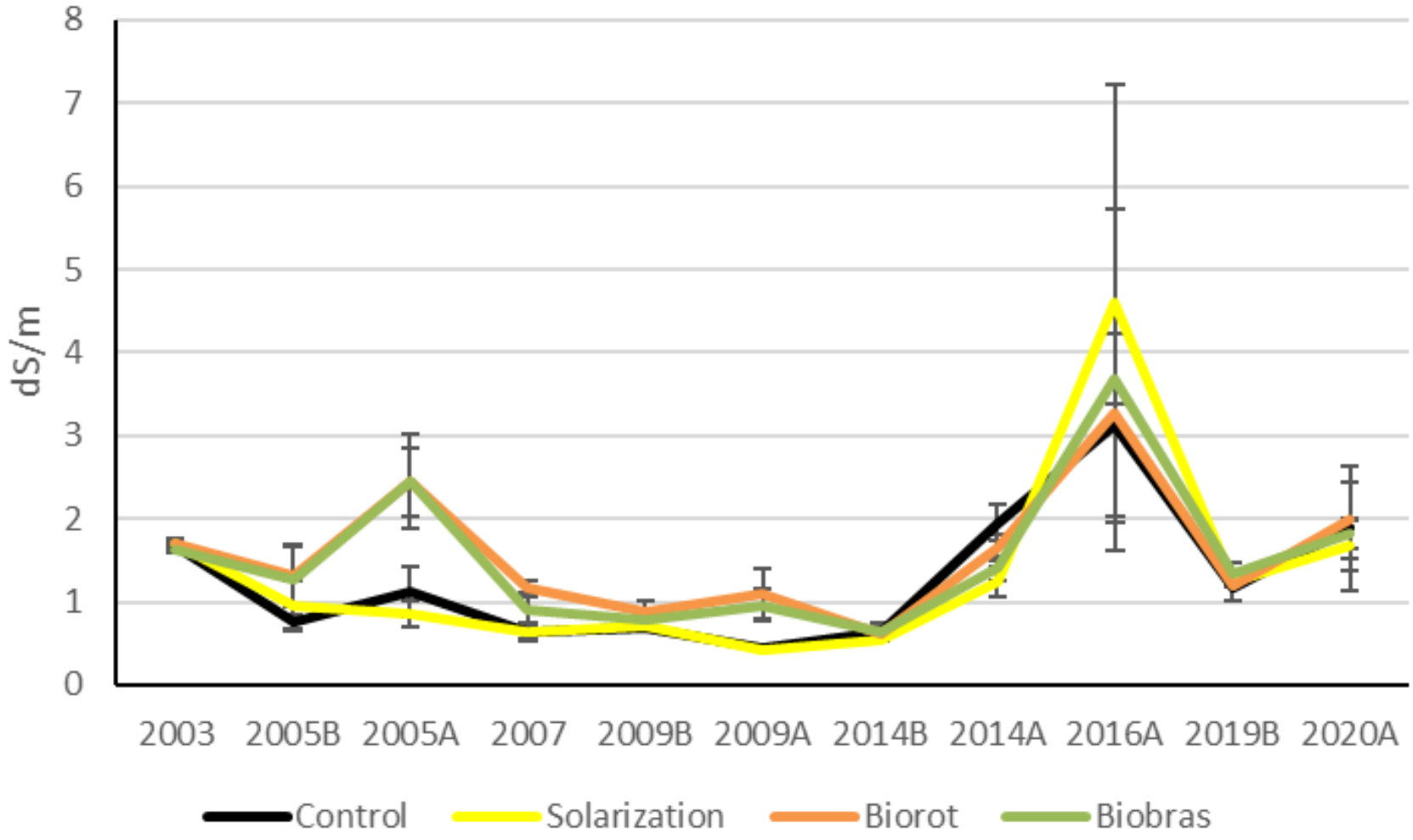


Results

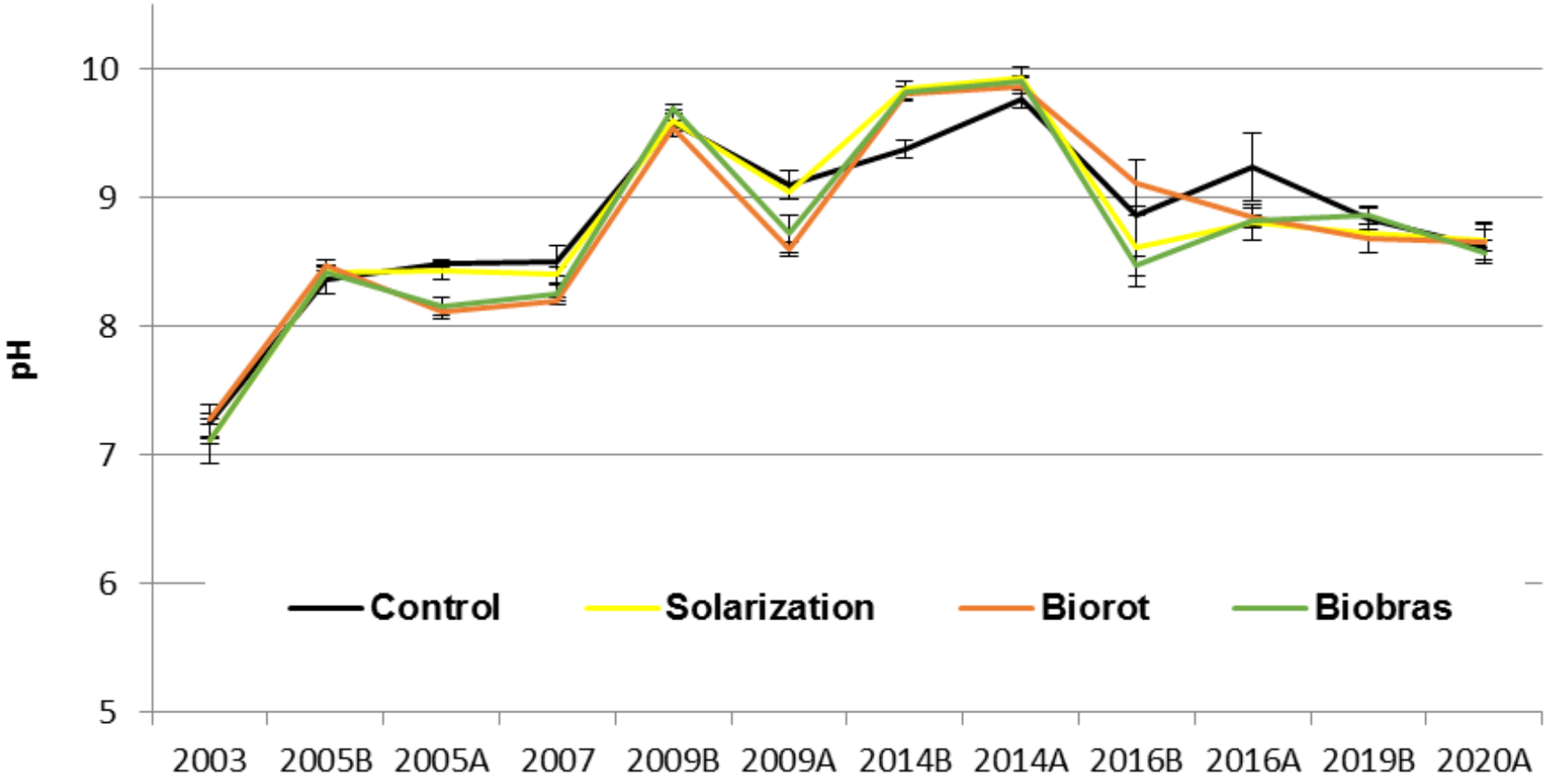
Soil properties and yield

Effect of treatments on soil electric conductivity



B= before; A= after treatments. Biorot= succession of different organic matters, Biobras= biofumigation with Brassicas.

Effect of treatments on soil pH

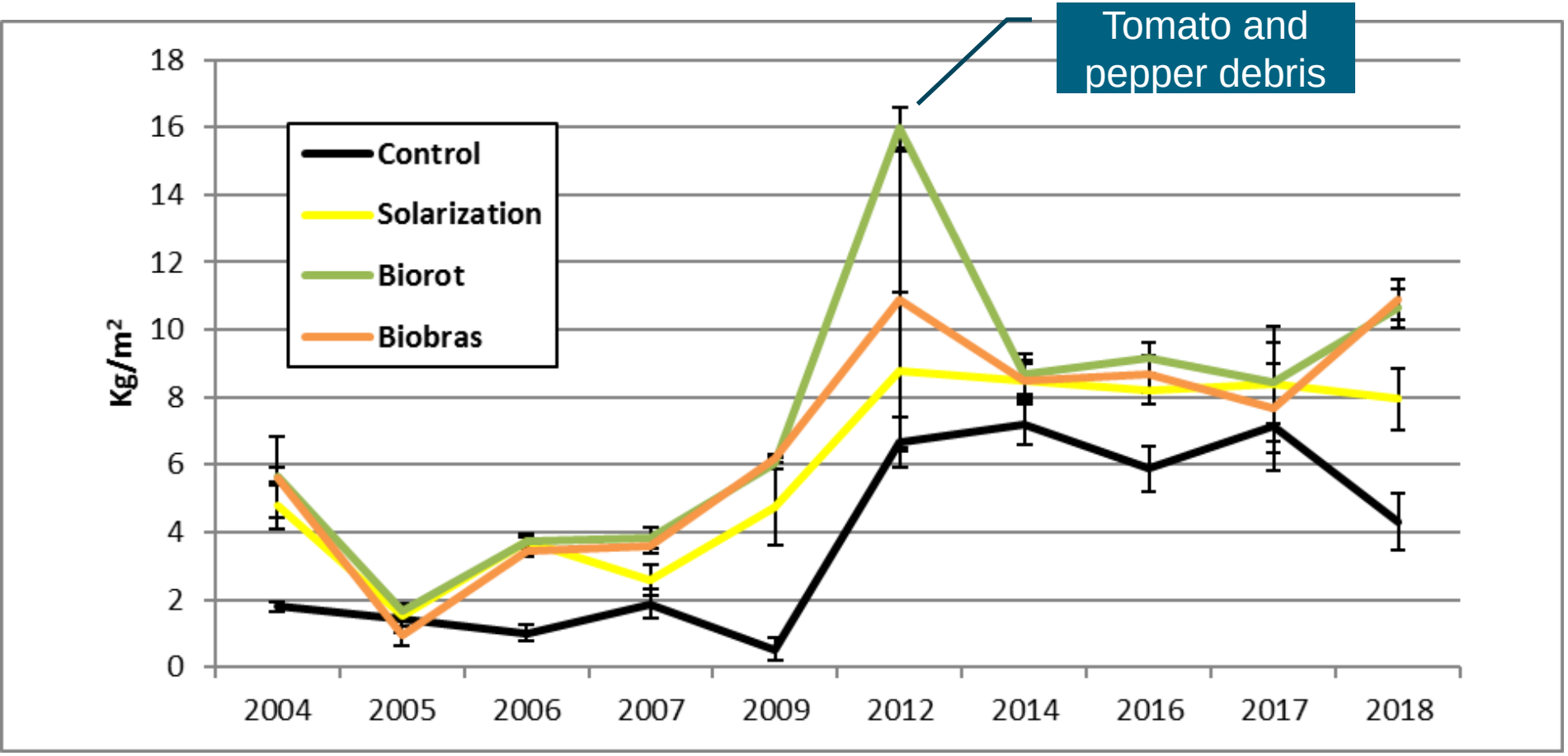


B= before; A= after treatments. Biorot= succession of different organic matters, Biobras= biofumigation with Brassicas.

Effect of treatments on soil organic matter

B= before; A= after treatments. Biorot= succession of different organic matters, Biobras= biofumigation with Brassicas.

Effect of treatments on tomato yield



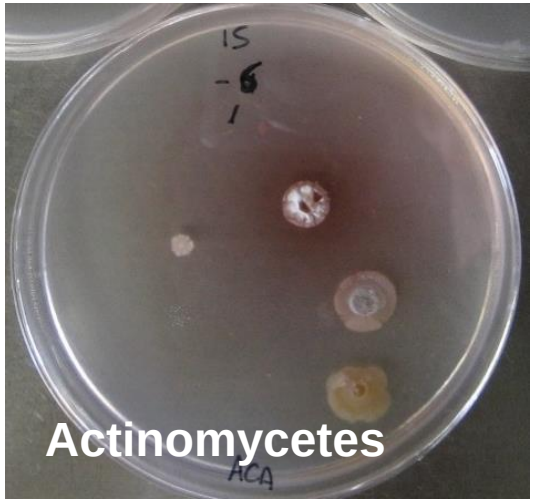
Biorot= succession of different organic matters, Biobras= biofumigation with Brassicas.

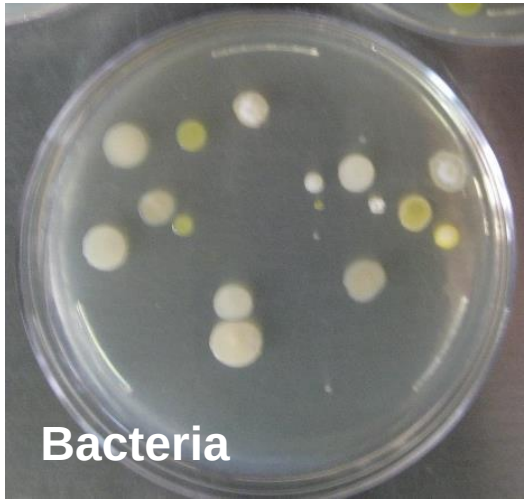
Actinomycetes and Bacteria population in biosolarized soils, 17 months after treatments (Peralta, 2017)

ANOVA and means for bacteria and actinomycetes CFUs 10^6/g of soil before transplanting.

	Actinomycetes	*Bacteria*
Trat.	**6.25****	**3.00***
Rep	0.65 N/S	5.29**
R^2	0,33	0,38
CV	19,07	12,46
$\dot{X}$	1,87	6,71
Trat.	***Actinomycetes***	***Bacteria***
Control	2.15 ± 0.39 **bc**	31.3 ± 4.7 **b**
Solarization	1.64 ± 0.24 **c**	36.6 ± 2.1 **ab**
Rotation of biofumigant	2.75 ± 0.30 **ab**	33.4 ± 3.8 **b**
Biosolarization with Brassicas	4 ± 0.54 **a**	42.4 ± 0.4 **a**

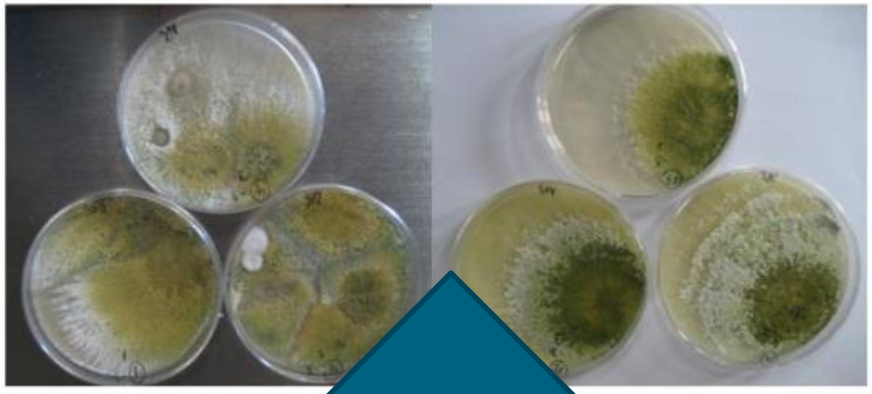
R^2= Determination coefficient ; CV= Variation coefficient; * = Significative with P ≤ 0,05; ** =Significative with P ≤ 0,01; ns= not significative.





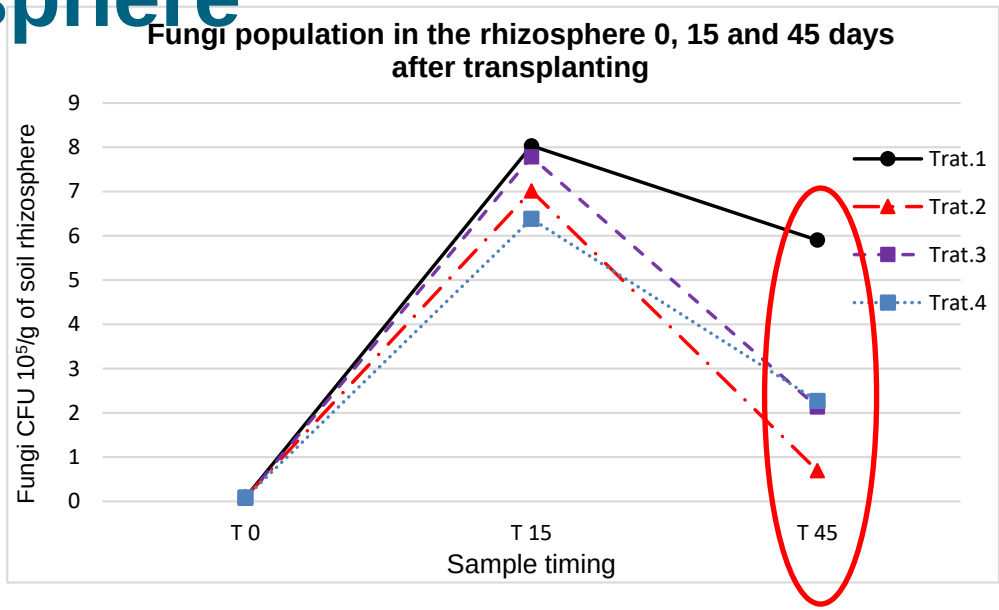
Peralta, R.; 2017

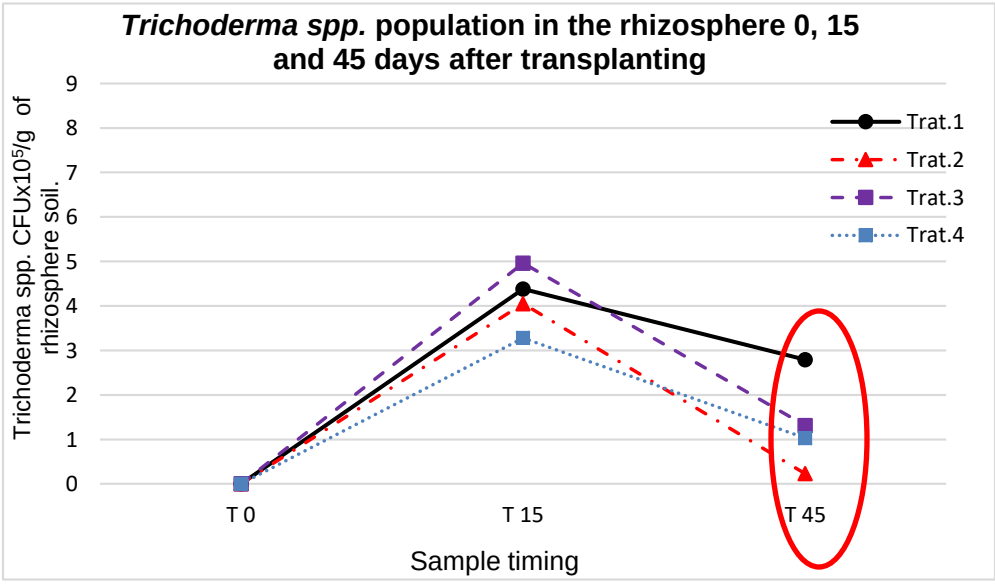
Fungi community in young tomato plants rhizosphere



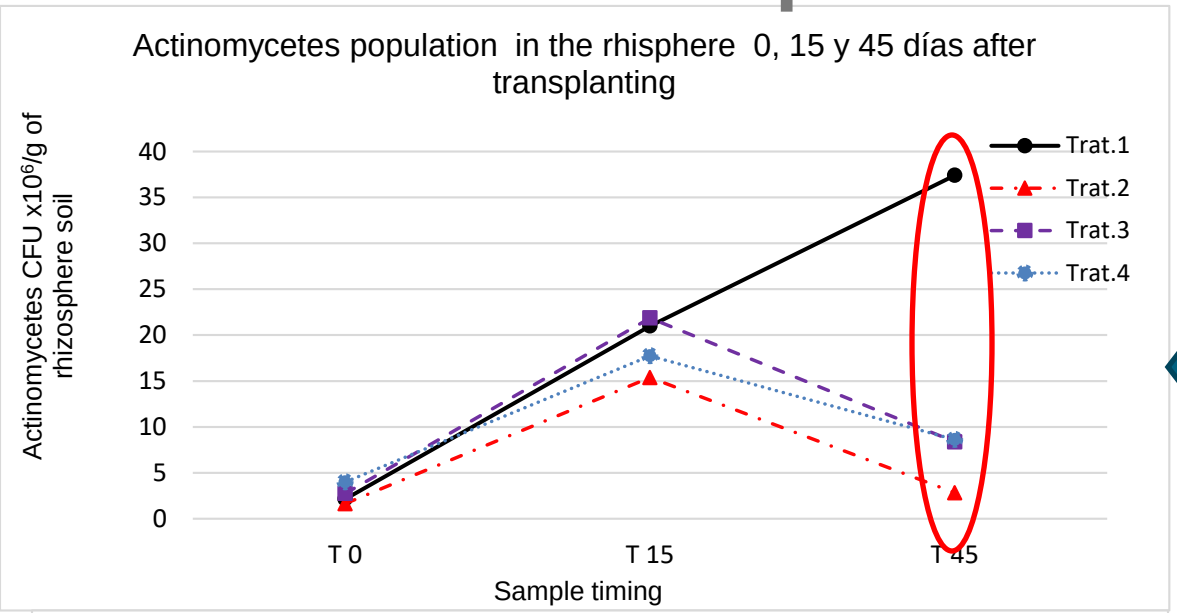
50% of fungi isolated from the rhizosphere where *Trichoderma spp*.
Peralta, R.; 2017

***Trichoderma spp*. population in the rizoplane was 10^5 CFU, superior to a dose obtained applying a commercial product dose 10^4 UFC.**

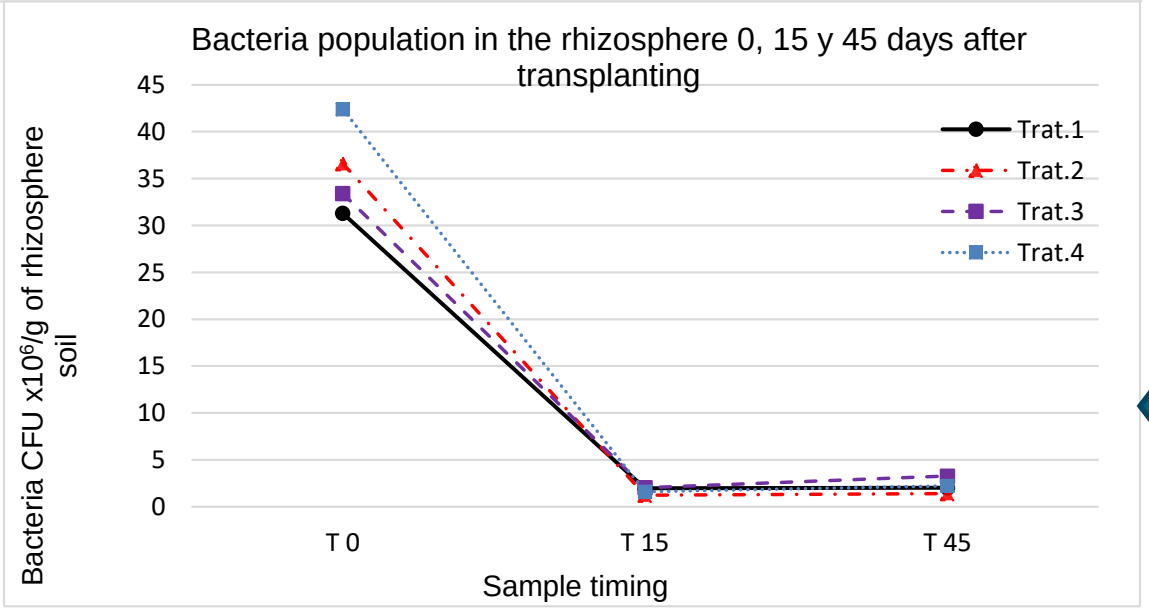




Actinomycetes and bacteria in young tomato plants rhizosphere



Significant differences between treatments, higher values for the control at 45 days after transplanting



No differences between treatments for bacteria population.

Good results were also obtained with other crops as lettuce, spinach, grafted tomato plants, broccoli, beets, sweet potato for seedlings production, etc.

Biofumigation in combination with solarization is an effective technique for managing soilborne pathogens in greenhouses and is being adopted by horticultural growers in Argentina.

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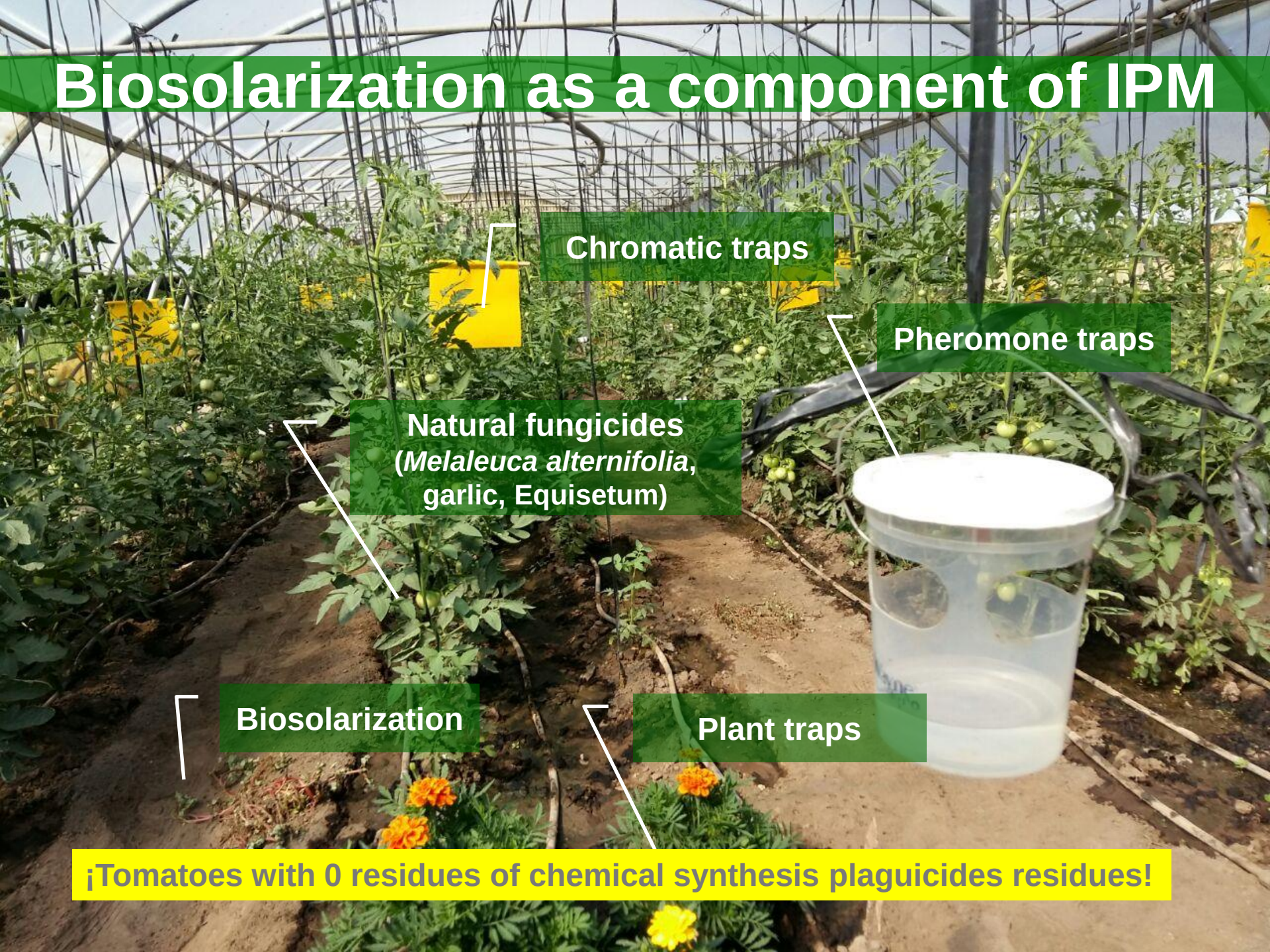
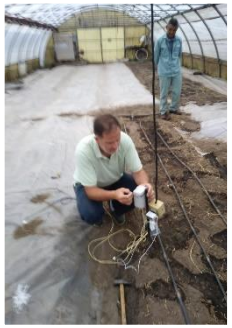
Biosolarization as a component of IPM



¡Tomatoes with 0 residues of chemical synthesis plaguicides residues!


















¡Thank you for you attention!

Mariel Mitidieri
mitidieri.mariel@inta.gob.ar